Summary Notes from 28 May 2008 Generic Technical Issue Discussion on Estimating Waste Inventory and Waste Tank Characterization

Attendees: Representatives from Department of Energy-Headquarters (DOE-HQ) and the U.S. Nuclear Regulatory Commission staff (NRC) met at the DOE offices in Germantown, Maryland on 28 May 2008. Representatives from Department of Energy-Savannah River (DOE-SR), Department of Energy-Richland (DOE-RL), and Department of Energy-River Protection (DOE-ORP) participated in the meeting via a teleconference link.

Discussion: NRC staff prepared and disseminated agenda topics (listed in the next section) summarizing issues and considerations relative to estimating waste inventory and waste tank characterization. A summary of the discussion regarding each agenda topic is provided below. The purpose of this meeting was for DOE and NRC staff to discuss the generic approaches for estimating waste inventory and waste tank characterization unrelated to any specific waste determination or pending DOE action.

Topics: The following five specific topical areas were discussed during the meeting:

1. Information needed
2. Characterization of residual post-treatment waste
3. Estimating post-closure inventory before removal activities are completed
4. Use of process knowledge to develop estimates of residual waste inventory
5. Evaluation of uncertainty

Summary: The following summarizes the discussion and the principal points of technical understanding identified during the meeting, unless otherwise noted.

Information needed

- NRC staff provided an overview of their first agenda topic and noted that DOE should include information about the generation of the waste streams identified in the waste determination, including any treatment processes that could influence the physical, chemical, or radiological characteristics of the

waste. In particular, a description is needed of any process which may lead to preferential removal of certain radionuclides, leading to variations in pre- and post-treatment distribution of radionuclides in the waste. NRC staff further noted that DOE should clearly explain the basis for the development of radionuclide inventories including the types of data, process history, or calculations used to make such estimates. Because radionuclide inventory is a function of concentration and volume of the waste, NRC staff believe the bases for both should be provided clearly. NRC staff also stated that information on the physical configuration of the inventory in the system and any simplifications to the actual configuration that are made to facilitate waste release modeling should be specifically pointed out in the performance assessment.

- NRC staff stated that preferential removal may affect inventories of certain radionuclides and should be addressed. DOE agreed that preferential removal (e.g. partitioning) might need to be addressed, if applicable. For instance, removed liquids are expected to contain different relative activities of radionuclides than residual solids remaining in a tank. For example, waste retrieval activities may lead to partitioning of certain radionuclides from the solid to liquid phase leading to preferential removal of radionuclides during tank washing activities.
- NRC staff noted that products of radioactive decay and ingrowth should also be addressed, as appropriate. DOE should clearly state when activities are decay corrected and consider changes in the relative activities of radionuclides over time.
- DOE asked whether addressing screening for radionuclides in this discussion would be appropriate. NRC staff agreed that this would be an appropriate topic to address in this discussion. NRC staff stated that the tailored National Council on Radiation Protection & Measurements (NCRP) Report No. 123 screening approach discussed in a specific technical topic meeting with DOE-SR in February 2007 was generally thought to be an acceptable approach.
- DOE further asked whether there might be a difference in the level of detail required for information used in a screening analysis of radionuclides versus the information used in a more detailed post-screening estimate of radionuclide inventories. NRC staff agreed, but noted that uncertainty needs

to be accounted for to ensure that all radionuclides are accounted for given the purposes for which the radionuclides may be used (e.g., transport analysis, classification, removal to the maximum extend practical) For example, key radionuclides for the groundwater pathway may be different than the list of radionuclides that contribute to worker doses.

- NRC staff noted that when assumptions are used DOE should provide the basis for those assumptions and be appropriately conservative.

Characterization of residual post-treatment waste

- NRC staff provided an overview of their second agenda topic and noted that DOE should provide the technical bases for characterization of the residual waste, including data quality objectives and sampling and analysis plans. NRC staff stated that the characterization of the waste should focus on determining the inventory of highly radioactive radionuclides that are expected to contribute most to the risk to members of the public, including inadvertent intruders, and workers.
- NRC staff further noted that DOE should provide information regarding the homogeneity of the waste. NRC stated that if the residual waste is not homogeneous, DOE should demonstrate that the number and locations of samples are sufficient and appropriate for characterizing the waste. NRC staff believes that if logistical reasons, such as access limitations, limit the ability to sample residual waste, DOE should justify why additional samples cannot be obtained. DOE should also describe the methodology used to determine the volume of residual waste.
- NRC staff stated that DOE should describe how the inventory will be represented in the performance assessment model and provide information demonstrating that this representation is appropriate given the actual configuration of the system.
- NRC staff noted that waste associated with ancillary equipment should be addressed, including the development of adequate inventory information for this equipment.
- NRC staff noted that there was a question about data quality objectives and sampling plans during the scoping phone call in preparation for this meeting.

NRC staff noted that this information is useful to NRC determining the pedigree of the information and how it is developed and applied in the performance assessment. NRC staff indicated that this is not intended to be an approval of data quality objectives and sampling plans prior to sampling being conducted, but is instead providing sufficient information to show how sampling was or will be completed to ensure data quality.

- NRC staff noted that in a case where data quality objectives cannot be met, or limited sampling data is available, this should be clearly discussed in either the performance assessment or the waste determination, and uncertainty resulting from poorer quality or lack of data evaluated.

Estimating post-closure inventory before removal activities are completed

- NRC staff provided an overview of their third agenda topic and noted that NRC staff recommends a conservative approach when DOE plans to estimate post-closure residual waste inventory before waste removal activities are completed. NRC staff stated that a conservative approach is also recommended when supporting technical bases are limited because significant underpredictions of the final inventory puts DOE at risk of not being able to demonstrate compliance with performance objectives at final closure.
- NRC staff further noted that DOE should justify assumptions regarding the removal efficiency that will be achieved and avoid overly optimistic and unsupported estimates of technology deployment effectiveness in the development of the source inventory used in performance assessment modeling.
- NRC staff believes that DOE should provide detailed information regarding its planned methodology for characterizing the residual post-treatment waste, and that DOE should explain the model and metric being used to determine the post-cleaning concentration estimates (e.g., statistical distribution, 95% upper confidence level, maximum, or mean) and how the inventory will be represented in the performance assessment model (e.g., spatial distribution of inventory within the modeling domain).
- DOE inquired whether averaging the radionuclide inventory across tanks would be appropriate since waste retrieval results for each tank are not likely to be exactly what was assumed in the performance assessment. DOE stated

that waste retrieval effectiveness may be higher in some tanks, and therefore the waste remaining in each tank may be above or below what is assumed in the performance assessment. NRC staff noted that because the point of compliance and peak dose may be a function of plume overlap from different sources (tanks), averaging or homogenization of the source inventory may potentially lead to an underprediction of the calculated doses depending on what highly radioactive radionuclides are under-estimated and in which tanks these radionuclides are located. Consideration of the inventory contribution from individual tanks is most important when credit is taken for the realistic configuration of the plume overlaps. Therefore, NRC staff stated that discrete representation of sources and source activities may be necessary where such credit is taken.

- NRC staff noted that the dose limits of the 10 CFR Part 61, Subpart C performance objectives apply to whole tank farms, not individual tanks.
- NRC staff stated that different tank designs and waste characteristics should be considered when grouping tanks for the purposes of estimating removal efficiencies.
- NRC staff and DOE agreed that the removal efficiencies assumed in the performance assessment for tank waste removal may be a target, but that actual retrieval efficiencies might be above or below predicted values. The retrieval effectiveness must still be demonstrated to have been to the maximum extent practical, but it may be different for each tank.
- DOE asked for examples of "unsupported assumptions". NRC staff noted an example of assuming a tank waste removal efficiency that had no basis. Applicability of previous applications or similarity to current situations would provide some basis for assumptions.
- Both DOE and NRC staff agreed that there needs to be a balance between conservatism of assumptions and realism. Realistic analyses are preferred when adequately supported. When there are large uncertainties more conservative assumptions may need to be made. What would be considered conservative for one application may not be for another. For example, NRC staff explained that a conservative assumption of a waste removal efficiency used to show that Criterion 2 is met might be conservatively high, whereas an

assumption of the same removal efficiencies for a performance assessment to meet Criterion 3 should be conservatively low.

Use of process knowledge to develop estimates of residual waste inventory

- NRC staff provided an overview of their fourth agenda topic and noted that where process knowledge is relied upon to develop estimates of residual waste inventory, such as ORIGEN2 calculations based on cladding, fuel types, burnup levels, cooling times, and other parameters, DOE should explain how these estimates are affected by waste removal activities that occurred in different physical phases (e.g., liquids vs. precipitated solids).
- NRC staff believes that inventory estimates based on historical or process knowledge and special calculations are more uncertain than estimates based on sample measurements. NRC staff stated that, where possible, results based on multiple historical or process knowledge approaches should be cross-compared, and/or individual results based on historical or process knowledge should be compared with sample results in order to assess the reliability of the estimates based on historical or process knowledge.
- NRC staff noted that the example supplied by Savannah River of comparing the predicted values by the waste characterization system to sample values was useful to support the validity of assumptions concerning process knowledge.
- NRC staff noted that it is also important to ensure that there are not any important waste streams that may have been missed that would affect inventory.
- DOE and NRC staff agreed that it is necessary to recognize the limitations of the data sets relied on to develop the inventory and to determine whether there are any data gaps that should be filled. For example, data systems that are used to develop radionuclide inventories for which the primary purpose is safety concerns such as corrosion, flammability or criticality as opposed to performance assessment may not provide sufficient inventory information for highly radioactive radionuclides.

Evaluation of uncertainty

- NRC staff provided an overview of their fifth agenda topic and noted that DOE should focus its uncertainty analyses on highly radioactive radionuclides. NRC staff stated that the major sources of uncertainty associated with final inventory estimates should be identified, including the uncertainties in the concentration and the residual volume.
- NRC staff noted that the sources of uncertainties considered should include: Uncertainty in analytical methods; uncertainty due to limited number of samples; uncertainty due to nonhomogeneity of waste; uncertainty due to reliance on process knowledge; and uncertainty in knowledge of historical waste streams. NRC staff further noted that if waste removal activities have not been completed, uncertainty in removal efficiencies should be evaluated.
- NRC staff commented that the relative contributions of these factors to the total uncertainty of the inventory estimates should be determined, and that the uncertainty in post-cleaning or calculated inventory estimates should be considered when performing risk analyses used to screen radionuclides for additional analysis and characterization.
- NRC staff believe that DOE should evaluate the effect of uncertainty in the inventory estimates on the results of its performance assessment, and that DOE should manage uncertainty in the inventory with conservative assumptions in the absence of more certain data to support its inventory estimates.
- NRC staff noted that uncertainties should be determined and presented quantitatively as much as possible.
- DOE and NRC staff agreed that highly radioactive radionuclides that are important to risk and performance should be emphasized in uncertainty analysis.
- DOE and NRC staff discussed the application of a graded approach in addressing uncertainties, in which greater efforts are expended on understanding and documenting the largest contributors to overall uncertainty.
- DOE noted that sampling for high-level waste tanks can be expensive and that there will tend to be a reliance on process knowledge and history. NRC noted that a good faith effort needs to be demonstrated to obtain or develop a good

inventory based on sampling data to the extent practical and that all information available should be used to develop and determine the uncertainty associated with inventory estimates. NRC staff and DOE agreed that the degree to which samples are needed depends on the degree of uncertainty.

- NRC staff also noted that if sampling is going to be limited, then it should be strategically applied to the most important areas and radionuclides, i.e., those that are most risk significant.
- DOE and NRC staff agreed that how much credit is being taken, how uncertain it is, and how close the performance assessment is to the limit are drivers in determining how much quantitative analysis of uncertainty is needed.

Conclusions and Actions:

- DOE and NRC staff agreed on the approaches described above related to estimation of inventory and tank waste characterization. No outstanding issues were identified relative to these topics at this time.